

Application No. 10/824,719
Technology Center 1745
Amendment dated October 1, 2007
Reply to Office Action dated May 29, 2007

Amendments to the Drawings:

The attached one (1) sheet of drawings includes changes to Figure 3.

This sheet, which includes Figure 3 only, replaces the original drawing sheet that also included Figure 3 only. In Figure 3, previously omitted reference number 44 has been added.

Attachment: Replacement Sheet (1)

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REMARKS

As of the filing of the present Office Action, claims 1-37 were pending in the above-identified US Patent Application. In the Office Action, the Examiner withdrew claims 25-37 from consideration due to a restriction requirement, objected to the drawings, rejected claims 20 and 24 under 35 USC §112, second paragraph, and rejected claims 1-24 under 35 USC §102 and/or §103. In response, Applicants have amended the specification, drawings, and claims as set forth above. More particularly:

The specification has been amended to correct spelling errors and for readability.

In amended Figure 3, the previously omitted reference number 44 has been added.

Independent claim 1 has been amended to incorporate the limitations of its dependent claim 2, and to recite a limitation that finds support in Applicants' specification at page 11, lines 22-25, and Figures 2, 4, and 5.¹

In view of its limitation being incorporated into its parent claim 1,

¹ According to MPEP §2163 II.A.3(a), "drawings alone may provide a 'written description' of an invention as required by [35 USC §112, first paragraph]," and "[i]n those instances where a visual representation can flesh out words, drawings may be used in the same manner and with the same limitations as the specification." (Citations omitted).

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dependent claim 2 has been amended to recite a limitation that finds support in Applicants' specification at page 13, lines 13-16.

Dependent claim 8 has been rewritten in independent form to include all of the limitations of its base claim 1, as well as dependent claims 2 and 15, and to recite limitations found in Applicants' specification at page 19, line 28-page 20, line 4.

Claims 3, 5, 7, 9, 13, 17, and 19-23 have been amended for clarity and, where appropriate, consistency with their parent claim 1 or 8.

Claim 10 has been amended for clarity and to recite a limitation that finds support at page 17, lines 5-7.

Claim 11 has been amended for clarity and to recite a limitation that finds support at page 16, lines 4-7.

Claim 12 has been amended for clarity and to recite a limitation that finds support at page 16, lines 3-5.

Claim 14 has been amended for clarity and to recite a limitation that finds support at page 17, lines 25-28.

Claims 15 and 16 have been amended for clarity and consistency with Applicants' specification at page 8, lines 3-7.

Claim 18 has been amended for clarity and consistency with

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Applicants' specification at page 8, lines 8-9.

Claim 24 has been amended for clarity and consistency with
Applicants' specification at page 5, lines 2-11.

Claims 25-37 have been canceled without prejudice in response to
the restriction requirement.

Applicants believe that the above amendments do not present new
matter. Favorable reconsideration and allowance of claims 1-24 are
respectfully requested in view of the above amendments and the following
remarks.

Objection to the Drawings

The Examiner objected to the drawings for lacking reference number
44 in Figure 3. As noted above, Applicants hereby present a "Replacement
Sheet" with corrected Figure 3, in which reference number 44 has been
added. Accordingly, Applicants respectfully request withdrawal of the
Examiner's objection to the drawings.

Rejections under 35 USC §112, Second Paragraph

Claims 20 and 24 were rejected as being indefinite for failing to

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particularly point out and distinctly claim the subject matter that Applicants regard as their invention.

Regarding claim 20, the Examiner questioned the meaning of the "hydrogen storage member is formed from a silicon wafer," and whether the "silicon wafer" is monocrystalline silicon or waste. Applicants believe the former is clarified by the amendment to claim 20 (which now recites that the "porous silicon is a silicon wafer"), and Applicants respectfully note that the wafer may be monocrystalline and/or waste, as both find support in the specification.

Regarding claim 24, Applicants believe the basis for this rejection is overcome by the clarifications made by amendment to this claim.

In view of the above, Applicants respectfully request withdrawal of the §112 rejections.

Claim Interpretation

The Examiner indicated that the "means for" clause in claim 16 was not being interpreted as invoking 35 USC §112, sixth paragraph. Claim 16 has been amended to address a typographical error which Applicants believe overcomes the Examiner's concern. Applicants further note that claim 15, and

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not claim 16 (which depends from claim 15), invokes 35 USC §112, sixth paragraph.

Rejection under 35 USC §102

Independent claim 1 and its dependent claims 2-5, 15, and 21-24 were rejected as anticipated by U.S. Patent No. 4,265,720 to Winstel. Applicants respectfully request reconsideration of this rejection in view of the amendments presented above as well as the following comments.

Applicants' amended independent claim 1 recites a "system for storing and retrieving elemental hydrogen, said system comprising a hydrogen storage member comprising a block of porous silicon having interior surfaces adapted to adsorb and store hydrogen." In contrast, though Winstel discloses the use of silicon as a hydrogen storage member, Winstel does not disclose or suggest that the silicon is in block form. Instead, Winstel discloses the silicon as being in the form of a very thin (ten micrometers) layer 2 deposited on a substrate 1 formed of a material other than silicon.

Though the Examiner cited Winstel's silicon layer 2 as being porous, Applicants cannot find any support in Winstel for this assertion. Regarding this issue, Winstel teaches that palladium absorbs hydrogen within its crystal

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lattice (column 1, lines 11-20). It is well known that hydrogen atoms are able to diffuse into materials, hence the phenomenon of hydrogen embrittlement in metals. Winstel also consistently refers to hydrogen being absorbed by his silicon layer 2, and as such appears to suggest that hydrogen storage is by diffusion into the silicon layer 2. However, Applicants' invention is based on hydrogen adsorption by silicon - adsorption is a surface phenomenon that involves dangling bonds (which Winstel appears to dismiss as irrelevant at column 2, lines 26-32). Because Winstel discloses hydrogen absorption, it would seem contrary to Winstel to introduce porosity in his silicon layer 2, since doing so would reduce the amount of silicon available for hydrogen absorption. Therefore, Applicants respectfully disagree with the assertion at page 10 of the Office Action that Winstel's silicon surface layer 2 "would obviously have porosity" and "it is obvious that there must be a percent void volume percent due to the purpose of the silicon," since Winstel does not disclose the layer 2 as being porous, and discusses hydrogen absorption but not hydrogen adsorption, contrary to Applicants' teachings.

In view of the above, Applicants believe that Winstel does not anticipate independent claim 1 or any of its dependent claims, and therefore respectfully request withdrawal of the rejection under 35 USC §102.

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Rejection under 35 USC §102/103

Claims 1 and 8-14 were rejected as being anticipated by, or alternatively, unpatentable over U.S. Published Patent Application No. 2004/0165187 to Koo et al. (Koo). Applicants respectfully request reconsideration of this rejection in view of the amendments presented above as well as the following comments.

Applicants' amended independent claim 1 has been amended to incorporate the limitations of its dependent claim 2, which was not rejected on the basis of Koo. As such, Applicants believe the rejection of claim 1 based on Koo has been overcome. Though dismissed by the Examiner, Applicants further believe the recitation in the preamble requiring Applicants' claimed invention to be a "system for storing and retrieving elemental hydrogen" is not merely an "intended use."

"[C]lear reliance on the preamble during prosecution to distinguish the claimed invention from the prior art transforms the preamble into a claim limitation because such reliance indicates use of the preamble to define, in part, the claimed invention...."

MPEP 2111.02.II., citing *Catalina Mktg. Int'l v. Coolsavings.com, Inc.*, 289 F.3d at 808-09, 62 USPQ2d at 1785.

Applicants hereby assert that they are relying on the preamble to distinguish

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their claimed invention from Koo, in that Koo is completely unrelated to systems and methods for storing and retrieving elemental hydrogen.

Regarding claim 8 and its dependent claims 9-14, as now amended claim 8 further requires "means for releasing stored hydrogen from said silicon columns." Koo does not disclose or suggest anything capable of releasing stored hydrogen from Koo's porous silicon structures. As such, Applicants believe that Koo does not anticipate or obviate independent claim 8 or any of its dependent claims, and therefore respectfully request withdrawal of the rejection under 35 USC §102/103 based on Koo.

Rejections under 35 USC §103

Claims 6, 7, and 16-20 were rejected as being unpatentable over Winstel alone or in further view of U.S. Patent No. 5,797,269 to Nishimura et al. (Nishimura), U.S. Patent No. 5,360,461 to Meinzer, or Japanese Patent Abstract 08-33031 to Masataka et al. (Masataka). Applicants respectfully request reconsideration of these rejections in view of the claims as amended and the following comments.

Claim 6 depends from claim 1, and was rejected solely in view of

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Winstel. In essence, the rejection was on the basis that

[Winstel's] silicon surface layer is used to absorb and release the hydrogen in the hydrogen storage container and because this is the silicon's use in the hydrogen storage member of Winstel it would obviously have porosity [and] it is obvious that there must be a percent void volume percent due to the purpose of the silicon. (Emphasis added.)

As previously discussed in reference to the §102 rejection based on Winstel, Applicants respectfully disagree with this conclusion. While Winstel discloses hydrogen absorption (presumably by diffusion), Applicants invention is based on the surface phenomenon of hydrogen adsorption. Because Winstel discloses hydrogen absorption, introducing porosity in Winstel's silicon layer 2 would reduce the amount of silicon in his layer 2 available for hydrogen absorption - a result that would be contrary to Winstel's teachings. Therefore, Applicants respectfully disagree with the assertion that Winstel's silicon surface layer "would obviously have porosity" and "it is obvious that there must be a percent void volume percent due to the purpose of the silicon."

Furthermore, Winstel does not disclose or suggest that the silicon is in block form. Instead, Winstel's silicon is a very thin layer 2 (about ten micrometers) on a substrate 1 formed of a material other than silicon.

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In view of the above, Applicants believe that Winstel does not obviate independent claim 1, from which claim 6 depends, and Applicants therefore respectfully request withdrawal of the rejection of claim 6 under 35 USC §103.

Claim 7 depends from claim 1, and was rejected in view of Winstel and Nishimura, the latter of which was cited for disclosing a hydrogen storage member in combination with a temperature sensor 60 (Figure 8). However, temperature sensors are not “electronic integrated circuits,” but instead are typically merely formed by a junction of two dissimilar alloys that generate a voltage proportional to temperature. In contrast, by definition an integrated circuit includes a semiconductor, which Nishimura’s temperature sensor lacks. Neither Winstel nor Nishimura disclose or suggest a semiconductor capable of having an integrated circuit formed in its surface and capable of adsorbing hydrogen. Therefore, Applicants believe that the combination of Winstel and Nishimura does not obviate claim 7, and Applicants respectfully request withdrawal of the rejection of claim 7 under 35 USC §103.

Claims 16-18 depend from claim 1, and were rejected in view of

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Winstel and Meinzer, the latter of which was cited for disclosing the release of hydrogen from a hydrogen storage member 2 using light from a light-emitting diode 18. However, Meinzer uses a wavelength of "approximately 500 nm" to activate the bond between hydrogen and magnesium hydride. It is well known that chemical bonds have distinct energies, and the energies of a hydrogen-magnesium hydride bond and a hydrogen-silicon bond are not the same. What works for one will not work for the other. A wavelength of approximately 660 nm is required to release the bond between hydrogen and silicon, a value which is 27% larger than that in Meinzer. Furthermore, Meinzer fails to address the critical issue of transparency. In Meinzer, light can only activate the surfaces of the magnesium hydride (or other metal hydride) because metal hydrides are opaque to light. Silicon is transparent to light (in the 660 nm range), so that even hydrogen bonds deep within Applicants' porous silicon can be activated. Therefore, Meinzer does not disclose or suggest the significantly longer wavelength claimed by Applicants.

In view of the above, Applicants believe that the combination of Winstel and Meinzer does not obviate claims 16-18, and Applicants respectfully request withdrawal of the rejection of these claims under 35 USC §103.

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Claims 19 and 20 depend from claim 1, and were rejected in view of Winstel and Masataka, the latter of which was cited for disclosing a monocrystalline silicon wafer. However, because Winstel discloses a very thin, nonporous silicon layer 2 and does not disclose or even suggest the use of a block of porous silicon, any combination of Winstel and Masataka would yield a nonporous monocrystalline silicon layer 2, not Applicants' claimed a porous block of monocrystalline silicon. Accordingly, Applicants believe that the combination of Winstel and Masataka does not obviate claims 19 and 20, and Applicants respectfully request withdrawal of the rejection of these claims under 35 USC §103.

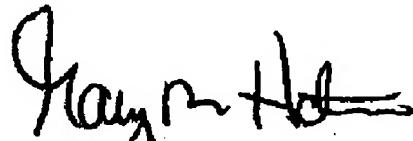
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Closing

In view of the above, Applicants believe that all issues outstanding from the Office Action have been addressed, and that the claims define patentable novelty over all the references, alone or in combination, of record. It is therefore respectfully requested that this patent application be given favorable reconsideration.

Should the Examiner have any questions with respect to any matter now of record, Applicants' representative may be reached at (219) 462-4999.

Respectfully submitted,



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Attachments: Replacement Drawing Sheet; Petition for Extension of Time;
Fee Transmittal form